

IN THE CLAIMS

Claims 1-33 Canceled.

34. (Currently amended) A semiconductor device manufacturing method comprising the steps of:

generating a film-forming gas of (1) ~~by using any one of a~~ silicon-containing ~~silicon-contained~~ organic compound having a siloxane bond and a silicon-containing ~~silicon-contained~~ organic compound having a CH₃ group and (2) ~~in addition~~ H₂O;

setting a flow rate ratio of H₂O to the silicon-containing ~~silicon-contained~~ organic compound to 4 or more; ~~and~~

adjusting ~~a gas~~ pressure of the film-forming gas to 1.5 Torr or more;

applying a power to the film-forming gas to generate a plasma thereof so as to react it, and thus forming a low-dielectric insulating film on a substrate;

generating a process gas containing at least ~~any~~ one of He, Ar, H₂ and deuterium;

generating a plasma by applying a power to the process gas; ~~and~~

bringing the low-dielectric insulating film into contact with the plasma of the process gas; and

removing a surface layer of the low-dielectric insulating film.

35. (Canceled)

9 36. (Currently amended) A semiconductor device manufacturing method according to claim 3435, wherein the step of removing the surface layer of the low-dielectric insulating film is followed by the further subsequent step of:

heating ~~increasing a temperature of~~ the low dielectric insulating film to 375 °C or more at an atmospheric pressure or a lower low-pressure, and then bringing the low-dielectric insulating film into contact with a process gas having a CH₃ group, while the low-dielectric insulating film is not brought into contact with ambient ~~an atmosphere~~.

3 37. (Currently amended) A semiconductor device manufacturing method according to claim 34, wherein C_xH_y (wherein x ; and y are each a positive integer), $C_xH_yF_z$ (wherein x and y are each 0 or a positive integer but not simultaneously 0, and z is a positive integer) or $C_xH_yB_z$ (wherein x ; and y are each 0 (where, except the case $x=y=0$) or a positive integer but not simultaneously 0, and z is a positive integer) is added to the film forming gas.

4 38. (Previously presented) A semiconductor device manufacturing method according to claim 34, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.

5 39. (Currently amended) A semiconductor device manufacturing method comprising the steps of:

generating a film-forming gas of (1) by using any one of a silicon-containing ~~silicon-contained~~ organic compound having a siloxane bond and a silicon-containing ~~silicon-contained~~ organic compound having CH_3 group and (2) in addition ~~H₂O~~;

setting a flow rate ratio of H_2O to the silicon-containing ~~silicon-contained~~ organic compound to 4 or more; and

adjusting a gas pressure of the film-forming gas to 1.5 Torr or more;

applying a power to the film-forming gas to generate a plasma thereof so as to react it, and thus forming a low-dielectric insulating film on a substrate; and

annealing the low-dielectric insulating film in an atmosphere of a nitrogen gas or an inert gas at a temperature of 400 °C or more; and then

removing a surface layer of the low-dielectric insulating film.

40. (Canceled)

6 41. (Currently amended) A semiconductor device manufacturing method according to claim 39, wherein the step of removing the surface layer of the low-dielectric insulating film is followed, without bringing the low-dielectric insulating film into contact

with ~~ambient an~~ atmosphere, by the further ~~subsequent~~ step of:

~~heating increasing a temperature of the low-dielectric insulating film to 375 °C or more at an atmospheric pressure or a lower low-pressure, and then bringing the low-dielectric insulating film into contact with a process gas having a CH₃ group.~~

7 42. (Currently amended) A semiconductor device manufacturing method according to claim ~~39~~³⁹, wherein C_xH_y (wherein x; and y are each a positive integer), C_xH_yF_z (wherein x and y are each 0 or a positive integer, but not simultaneously 0, and z is a positive integer) or C_xH_yB_z (wherein x; and y are each 0 (where, except the case x=y=0) or a positive integer, but not simultaneously 0, and z is a positive integer) is added to the film forming gas.

8 43. (Currently amended) A semiconductor device manufacturing method according to claim ~~34~~³⁴, wherein wiring electrodes consisting mainly of a copper film are formed on the substrate.

9 44. (Currently amended) A semiconductor device manufacturing method comprising the steps of:

generating a film-forming gas at a pressure below 1.0 Torr, said film-forming gas containing (1) by using any one of a silicon-containing silicon-contained organic compound having a siloxane bond and a silicon-containing silicon-contained organic compound having a CH₃ group and (2) in addition H₂O; and

setting a flow rate ratio of H₂O to the silicon-containing silicon-contained organic compound to 12 or more;

~~increasing a temperature of heating~~ a substrate ~~up to 200 °C or more but no higher than 400 °C or less;~~ and

~~applying a power to the film-forming gas of a frequency below 1MHz to the substrate to bias the substrate and to generate a plasma thereof of the film-forming gas so as to react it, and thus forming a barrier insulating film on the heated substrate whose temperature is raised.~~

45. (Canceled)

10 46. (Currently amended) A semiconductor device manufacturing method according to claim 44, wherein, ~~in the step of generating the film-forming gas, a pressure of the film forming gas is adjusted to below 1.0 Torr and, in the step of forming the barrier insulating film, a power of a frequency of below 1MHz is applied to the substrate to bias the substrate while at least the power of the a frequency of 1MHz or more out of the power of the frequency of below 1MHz or the power of the frequency of 1MHz or more is applied to the film-forming gas, whose pressure is adjusted to 1.0 Torr or more, to generate a plasma thereof so as to react it, and thus the barrier insulating film is formed.~~

11 47. (Currently amended) A semiconductor device manufacturing method according to claim 44, wherein dinitrogen monoxide (N_2O) is added, or nitrogen (N_2) or ammonia (NH_3) is added, or dinitrogen monoxide (N_2O) and ammonia (NH_3) are added to the film-forming gas.

12 48. (Currently amended) A semiconductor device manufacturing method according to claim 44, wherein C_xH_y (wherein x ; and y are each a positive integer), $C_xH_yF_z$ (wherein x and y are each 0 or a positive integer, but not simultaneously 0, and z is a positive integer) or $C_xH_yB_z$ (wherein x ; and y are each 0 (where, except the case $x=y=0$) or a positive integer, which are but not simultaneously 0, and z is a positive integer) is added to the film forming gas.

13 49. (Previously presented) A semiconductor device manufacturing method according to claim 44, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.

14 50. (Currently amended) A semiconductor device manufacturing method comprising the steps of:

generating a film-forming gas of (1) ~~by using any one of a~~ silicon-containing ~~silicon-contained~~ organic compound having a siloxane bond and a silicon-containing ~~silicon-contained~~ organic compound having CH_3 group and (2) H_2O ;

setting a flow rate ratio of H_2O to the silicon-containing ~~silicon-contained~~ organic compound to 12 or more;

adjusting a pressure of the film-forming gas to below 1.0 Torr;

~~heating increasing a temperature of a substrate up to 200 °C or more but no~~ higher than 400 °C or less;

applying a power of a frequency of below 1MHz to the substrate to bias the substrate and to generate a plasma of the film-forming gas by the power of the frequency of below 1MHz so as to react the plasma, and thus forming a first insulating film;

~~again~~ generating said ~~the~~ film-forming gas;

adjusting a pressure of the film-forming gas to 1.0 Torr or more;

~~heating increasing a temperature of a substrate up to 200 °C or more but no~~ higher than 400 °C or less;

and

applying a power of a frequency of below 1 MHz to the substrate to bias the substrate while applying ~~at least the power at of the a~~ frequency of 1 MHz or more ~~out of the power of the frequency of below 1 MHz or the power of the frequency of 1 MHz or more to the film-forming gas, at a whose pressure of is adjusted to 1.0 Torr or more,~~ to generate a plasma thereof so as to react it, and thus forming a second insulating film on the first insulating film, whereby ~~the a~~ barrier insulating film composed of the first insulating film and the second insulating film is formed.

15 51. (Currently amended) A semiconductor device manufacturing method according to claim 50, wherein dinitrogen monoxide (N_2O) is added, or nitrogen (N_2) or ammonia (NH_3) is added, or dinitrogen monoxide (N_2O) and ammonia (NH_3) are added to the film-forming gas.

16/ 52. (Currently amended) A semiconductor device manufacturing method according to claim 50, wherein C_xH_y (wherein x; and y are each a positive integer), $C_xH_yF_z$ (wherein x and y are each 0 or a positive integer but not simultaneously 0, and z is a positive integer) or $C_xH_yB_z$ (wherein x; and y are each 0 (where, except the case $x=y=0$) or a positive integer, which are but not simultaneously 0, and z is a positive integer) is added to the film forming gas.

17/ 53. (Previously presented) A semiconductor device manufacturing method according to claim 50, wherein wirings or electrodes consisting mainly of a copper film are formed on the substrate.